

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
27 February 2003 (27.02.2003)

PCT

(10) International Publication Number  
**WO 03/016728 A1**

(51) International Patent Classification<sup>7</sup>: **F16B 37/06**  
(21) International Application Number: PCT/US02/24175  
(22) International Filing Date: 31 July 2002 (31.07.2002)  
(25) Filing Language: English  
(26) Publication Language: English  
(30) Priority Data:  
60/312,514 15 August 2001 (15.08.2001) US  
(71) Applicant (for all designated States except US): **FABRIS-TEEL PRODUCTS INCORPORATED** [US/US]; 22100 Trolley Industrial Drive, Taylor, MI 48180 (US).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

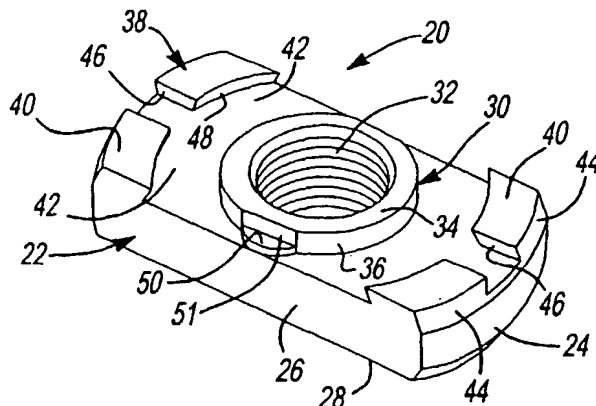
**Published:**

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(72) Inventors; and  
(75) Inventors/Applicants (for US only): **PARKER, John, M.** [US/US]; 2216 Independence, Ann Arbor, MI 48104 (US).  
**VRANA, John, J.** [US/US]; 540 Essex Drive, Rochester Hills, MI 48307 (US).  
(74) Agents: **SCOTT, Raymond, E.** et al.; Howard & Howard Attorneys, P.C., 39400 Woodward Avenue, Suite 101, Bloomfield Hills, MI 48034 (US).

(54) Title: SELF-ATTACHING FASTENER



(57) Abstract: A self-attaching fastener which may be formed by cold heading having a body including generally arcuate side faces and planar end faces, a central tubular pilot having a planar annular end face, a primary bearing surface surrounding the pilot and arcuate flanges extending from the side faces having planar surfaces spaced below the pilot end face, wherein one or both faces of the pilot and the flange portions facing the pilot are inclined. In one embodiment, the arcuate flange portions each comprise arcuate segments, preferably having inclined opposed surfaces, or the arcuate flanges may be continuous including an arcuate conical midportion and linear inclined side portions. Antirotation tabs may be integrally struck from either the pilot or the flanges.

WO 03/016728 A1

## SELF-ATTACHING FASTENER

### FIELD OF THE INVENTION

5           **[00001]**       This invention relates to a self-attaching fastener which may be utilized in mass production applications as a self-clinching or self-piercing and clinching fastener. More particularly, this invention relates to a self-attaching nut fastener which may be permanently installed in a metal panel in a die press with conventional installation apparatus.

10

### BACKGROUND OF THE INVENTION

**[00002]**       Self-attaching fastener systems including pierce and clinch nuts developed by the applicant have been used for many years in mass production applications, including the automotive industry. Pierce nuts of this type are conventionally formed by rolling the general configuration of the nut from steel bar stock, cutting the nuts to length and performing various finishing operations including piercing and threading the nut bore. Pierce nuts manufactured by this method are therefore rectangular and include a rectangular pilot portion having a threaded bore, rectangular flange portions on opposed sides of the pilot portion and panel receiving grooves located either in the opposed sides of the pilot portion or in the flange portions on opposed sides of the pilot portion. Self-attaching fasteners of this type may then be used as pierce and clinch nuts, wherein the end face of the pilot portion serves as a punch to pierce an opening in the panel or as a clinch nut, wherein the pilot portion is received through an opening in the panel and clinched to the panel.

**[00003]**       In mass production applications, the self-attaching fasteners are conventionally installed in a metal panel in a die press, wherein one of the die platens includes an installation head which receives the self-attaching fasteners for installation having a reciprocating plunger and a die member or die button in the opposed die platen which clinches the panel adjacent the panel opening into the nut grooves. Self-attaching fasteners of the type described above continue to enjoy commercial success particularly in mass production applications. Such self-attaching fasteners are

-2-

supplied either in bulk form, wherein the fasteners are supplied from a hopper to the installation head through chuting or the fasteners are supplied in a coil of preoriented fasteners interconnected by frangible wires as disclosed in U.S. Patent No. 3,711,931 assigned to the predecessor in interest of the assignee of this application and the method  
5 of installation is disclosed in U.S. Patent No. 3,648,747 also assigned to the predecessor in interest of the assignee of this application.

[00004] As will be understood by those skilled in this art, the configuration of the self-attaching fasteners is limited by the roll form method. Of course, there are numerous other fasteners and fastener systems which are formed by  
10 cold header techniques including self-attaching fasteners. However, the prior art does not disclose or suggest a self-attaching fastener which combines the advantages of the pierce and clinch nuts described above in a nut configuration which may be formed by cold heading techniques. Further, a rectangular self-piercing pilot pierces a square or rectangular opening in the panel which may create stress concentrations in the panel,  
15 particularly at the corners of the pierced rectangular opening. Finally, the prior art does not disclose a self-attaching fastener which may be formed by conventional cold heading techniques and which may be formed into a preoriented fastener strip for mass production applications. The self-attaching fastener of this invention combines the advantages of the roll formed pierce and clinch nuts described above in a fastener  
20 which may be formed by conventional cold heading techniques and which may be supplied in a preoriented coil of fasteners for mass production applications.

### SUMMARY OF THE INVENTION

[00005] As set forth above, the self-attaching fastener of this invention  
25 combines the advantages of the roll formed pierce and clinch nuts described above with the advantages of a fastener formed by conventional cold heading techniques and which may be supplied to a conventional installation head in either bulk or preoriented strip form. The self-attaching fastener of this invention also eliminates certain problems associated with conventional roll formed pierce and clinch nuts, including elimination  
30 of stress risers formed in the panel at the corners of the rectangular opening formed in the panel and cracking. The self-attaching fastener of this invention also increases the fatigue life of the fastener and panel assembly.

[00006] The self-attaching fastener of this invention includes a central generally cylindrical pilot portion having a planar annular end face, which serves as a piercing face when the fastener is used as a self-piercing fastener, a bore extending through the pilot portion through the end face and arcuate or generally semicircular flange portions on opposed sides of the pilot portion spaced from the pilot portion. Each of the flange portions include a planar generally arcuate panel supporting surface spaced below the plane of the end face of the pilot portion and a second planar bearing surface spaced below the plane of the panel supporting surface of the flange portions located between the flange portions and the pilot portion and generally surrounding the pilot portion. In one preferred embodiment, the surfaces of the flange portions opposite the pilot portion are inclined inwardly from the second bearing surface toward the pilot portion, such that the combination of the flange portions and the pilot portion form reentrant grooves which increase the push-off strength of the fastener when installed in a panel. The preferred embodiments of the fastener also include an antirotation feature which limits or prevents rotation of the fastener relative to the panel following installation. In one preferred embodiment, the fastener includes integral tab portions integral tab portions which may be integrally struck from the end face of the pilot portion which extend radially from the pilot portion toward the end faces of the fastener and flats on the pilot portion where the tabs are struck and which, in combination, provide improved torque resistance when threading a male fastener into the nut bore. In another preferred embodiment, notches are formed in the wall of the flange portions facing the pilot portion forming tabs overlying the panel supporting surfaces. These notches in combination with the tabs also provide improved torque resistance. In another preferred embodiment described further below, the generally arcuate flange portions of the fastener include an arcuate central portion and linear end portions providing excellent torque resistance.

[00007] The body portion of the self-attaching fastener of this invention preferably includes generally arcuate side faces and planar end faces, wherein the generally arcuate flange portions that project from the second bearing surface from the generally arcuate side surfaces to conform to the shape of the flange portions. In one of the preferred embodiments of the self-attaching fastener of this invention, the generally arcuate flange portions on opposed sides of the pilot portion comprise at least two

-4-

spaced arcuate segments and the second planar bearing surface extends between the spaced arcuate segments, providing additional torque resistance. In another preferred embodiment, the generally arcuate flange portions are continuous, each having an arcuate midportion and linear end portions integral with and extending from the midportion, and the flange portions opposite the pilot portion are inclined to provide additional bearing areas on the flange portions and push-off strength. Additional push-off strength may also be provided by inclining the opposed surfaces of the arcuate sections of the flange portions inwardly from the second bearing surface to the panel supporting surfaces. Further push-off strength may be provided by inclining the outer surface of the projecting pilot portion from the second bearing surface toward the flange portions. In the preferred embodiment of the fastener, wherein the pilot portion is inclined inwardly from the end face, which serves as a piercing face, the outer surface adjacent the end face is cylindrical to provide increased columnar support for piercing and then inclined inwardly, forming a frustoconical surface providing additional push-off strength for the fastener and panel assembly.

[00008] The self-attaching fastener of this invention may thus be formed by conventional cold heading techniques and provides superior performance over prior fasteners formed by cold heading. The fastener of this invention also provides the advantages of a cold rolled fastener without the expense of a rolling mill. Finally, the self-attaching fastener of this invention may be integrated in a preoriented fastener strip for mass production applications. For such applications, wire receiving grooves are provided in the second bearing surface preferably on opposed sides of the pilot portion between the pilot portion and the flange portions and extending between the end faces of the fastener body. In the preferred embodiment of a fastener strip, the wire grooves include a plurality of space pockets in the lower surface or bottom wall of the groove preventing movement of the fasteners on the wires. The fasteners may then be formed into a continuous preoriented fastener strip, wherein the fasteners are first oriented in end to end relation and a frangible wire is then rolled into the wire receiving grooves.

[00009] Other advantages and meritorious features of the self-attaching fastener of this invention will be more fully understood from the following description of the preferred embodiments, the appended claims and the drawings, a brief description of which follows.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[00010] Figure 1 is a top perspective view of one embodiment of the self-attaching fastener of this invention;

5 [00011] Figure 2 is a top view of the self-attaching fastener shown in Figure 1;

[00012] Figure 3 is an end view of the embodiment of the self-attaching fastener shown in Figures 1 and 2;

10 [00013] Figure 4 is a top view of the self-attaching fastener shown in Figures 1 to 3 attached to a metal panel;

[00014] Figure 5 is a side cross-sectional view in Figure 4 in the direction of view arrows 5-5;

[00015] Figure 6 is a cross-sectional view of Figure 4 in the direction of view arrows 6-6;

15 [00016] Figure 7 is a top perspective view of an alternative embodiment of the self-attaching fastener of this invention;

[00017] Figure 8 is a top perspective view of another embodiment of the self-attaching fastener of this invention;

20 [00018] Figure 9 is a top view of the self-attaching fastener shown in Figure 8;

[00019] Figure 10 is an end view of the self-attaching fastener shown in Figures 8 and 9;

[00020] Figure 11 is a top view of the self-attaching fastener shown in Figures 8 to 10 attached to a panel;

25 [00021] Figure 12 is a side cross-sectional view of the fastener and panel assembly shown in Figure 11 in the direction of view arrows 12-12;

[00022] Figure 13 is a cross-sectional view of the fastener and panel assembly shown in Figure 11 in the direction of view arrows 13-13;

30 [00023] Figure 14 is a top perspective view of an alternative embodiment of the self-attaching fastener of this invention;

[00024] Figure 15 is a top view of the self-attaching fastener shown in Figure 14;

[00025] Figure 16 is a cross-sectional end view of the self-attaching fastener shown in Figures 14 and 15;

[00026] Figure 17 is a top plan view of an alternative embodiment of the self-attaching fastener of this invention;

5 [00027] Figure 18 is a side cross-sectional view of the self-attaching fastener shown in Figure 17 in the direction of view arrows 18-18;

[00028] Figure 19 is a top perspective view of an alternative embodiment of the self-attaching fastener of this invention;

10 [00029] Figure 20 is a perspective top view of an alternative embodiment of the self-attaching fastener of this invention;

[00030] Figure 21 is a partial top view of the embodiment of the self-attaching fastener shown in Figure 20; and

[00031] Figure 22 is a top perspective view of a preoriented strip of fasteners as shown in Figures 7 to 9.

15

#### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

[00032] The embodiment of the self-attaching fastener 20 shown in Figures 1 to 3 includes a body portion 22 having arcuate side faces 24, planar end faces 26 and a bottom bearing surface 28. A tubular or annular generally cylindrical central pilot portion 30 projects from the body portion having a bore 32 extending through the pilot portion 30 and the body portion of the fastener which may be threaded, as shown. Alternatively, the bore 32 may be unthreaded for receipt of a thread forming or thread rolling male fastener. The pilot portion 30 includes a planar end face 34 which serves as a piercing face when the fastener 20 is used as a self-piercing fastener. In this embodiment, the outer wall 36 of the pilot portion is cylindrical. The fastener 20 further includes arcuate flange portions 38 on opposed sides of the pilot portion 30 which extend from the arcuate side faces 24 each having arcuate planar panel supporting or first bearing surfaces 40 which are spaced below the plane of the piercing end face 34 as best shown in Figure 3. The self-attaching fastener 20 further includes a second or main planar bearing surface 42 which is spaced below the plane of the first bearing surfaces 40 of the flange portions located between the flange portions 38 and the central pilot portion 30 and surrounds the pilot portion 30 as shown. In this

embodiment of the self-attaching fastener of this invention, the flange portions 38 are comprised of spaced arcuate segments 44 having opposed inclined surfaces 46 which are inclined inwardly from the second or main bearing surface 42 to the first or panel supporting bearing surfaces 44 providing increased push-off strength when the fastener is attached to the panel. Further, in the preferred embodiments, the surface or surfaces 48 of the flange portions opposite the pilot portion 30 are inclined from the main bearing surface 42 toward the pilot portion 30 as best shown in Figure 3. Finally, the self-attaching fastener 20 shown in Figures 1 to 3 includes integral tabs 50, which may be integrally struck from the piercing end face 34 of the pilot, as shown, forming flats 51 on opposed sides of the pilot portion. As will be understood by those skilled in this art, the fastener 20 illustrated in Figures 1 to 3 may be formed by conventional cold heading techniques.

[00033] As described further in the above-referenced U.S. Patent No. 3,648,747, self-piercing and clinching fasteners of the type shown are generally installed in a die press, wherein the upper platen of the die press includes an installation head (not shown) which receives the fasteners having a reciprocating plunger which engages the bottom bearing surface 28 and a die member or die button (not shown) in the lower die platen which receives the panel to be installed. The piercing face 34 then engages and pierces the panel and the panel portion adjacent the pierced opening is then inelastically permanently deformed into recesses in the fastener by projecting lips of the die button as will be understood by those skilled in this art. As will be understood, the piercing face 34 of the pilot portion 30 first engages the panel, then pierces an opening in the panel for receipt of the pilot portion. Alternatively, where the self-attaching fastener is utilized as a self-clinching fastener only, the panel is prepierced for receipt of the pilot. The panel is then received on the first bearing surface 40 of the flange portions 38. Finally, the lip portions of the die button (not shown) inelastically deform the panel portion adjacent the opening into the recesses provided in the fastener, completing the installation. The configuration of the clinching lips of the die button will depend upon the configuration of the fastener.

[00034] Figures 4 to 6 illustrate a panel and fastener assembly formed by the method and apparatus described above with the fastener 20 illustrated in Figures 1 to 3. Figure 4 is a top view of the panel 52 following installation, wherein the pilot



portion 30 extends through the panel 52 and the panel is supported on the panel supporting surfaces 40 of the flange portions 38 and deformed onto the main or second bearing surfaces 42. As best shown in Figure 5, the panel portion 54 is deformed against the main or second bearing surface 42 beneath the inclined surfaces 48 of the flange portions and the outer wall 36 of the pilot portion providing push-off strength and the panel is thinned and deformed around the tab portions 50 and against the flats 51 preventing rotation of the fastener 20 relative to the panel. As best shown in Figure 6, the panel 52 is also deformed against the primary bearing surface 42 beneath the opposed inclined surfaces 46 of the flange portions 38 providing additional push-off strength and preventing rotation of the fastener 20 on the panel. Because the pilot portion 30 is round, rather than rectangular, stress risers are avoided in the panel at the pilot and the arcuate or generally arcuate flange portions also provide improved retention of the fastener to the panel and avoids stress risers or cracking of the panel as described.

15           **[00035]**           The embodiment of the self-attaching fastener 120 illustrated in Figure 7 is identical to the fastener 20 illustrated in Figures 1 to 3 except the fastener 120 includes parallel wire receiving grooves 156 in the primary or second bearing surface 142 on opposed sides of the pilot portion 130. As shown, the wire grooves 156 extend from one end face 126 to the other. In the preferred embodiment, the wire receiving grooves include a plurality of spaced pockets 158 separated by ribs 160. As described in detail in the copending application filed concurrently herewith, the fasteners 120 may then be interconnected in a continuous preoriented strip of fasteners by aligning the fasteners 120 in end to end relation, such that the wire grooves 156 are coaxially aligned as shown in Figure 22 and frangible continuous wires 162 are rolled into the wire grooves 156. In the preferred embodiment, the wires are deformed by the rollers (not shown) against the bottom wall of the groove and deformed into the pockets 158. The retaining wires 162 are preferably formed of a flexible material permitting the preoriented strip of fasteners to be rolled into a coil, but may be cut during installation of the fastener by the plunger of the installation head (not shown). Thus, the wires are preferably flexible, but frangible. A suitable material for the wires is annealed 1065 carbon steel, which is not heat treated. This material provides sufficient ductility and flexibility for use in this application. Other suitable materials include

monofilament, nylon cord or cable and other suitable metals and polymers. Because the fastener 120 shown in Figure 7 is identical to the fastener 20 shown in Figure 1, the elements of the fastener are numbered in the same sequence as Figure 1 and no further explanation is required.

5           **[00036]**        Figures 8 to 10 illustrate a further alternative embodiment of the self-attaching fastener 220 of this invention. The self-attaching fastener illustrated in Figures 8 to 10 may be identical to the fastener 120 illustrated in Figure 7, except as stated below. The outer wall 236 of the pilot portion 230 adjacent the second bearing surface 242 is inclined outwardly from the second or primary bearing surface 242 of the fastener toward the flange portions 238 as best shown in Figure 10. Thus, the end face or piercing face 234 overlies the primary bearing surface 242 forming a dovetail-shaped opening between the inclined surfaces 248 of the flange portions and the opposed inclined surface 236 of the pilot portion as best shown in Figure 10. However, as shown, the outer surface 237 adjacent the end face 234 is preferably cylindrical to provide columnar support for piercing and the pilot portion 230 is substantially cylindrical. Because the embodiment of the self-attaching fastener 220 shown in Figures 8 to 10 is identical to the fastener 120 illustrated in Figure 7 including the wire receiving grooves 256 except for the inclined surface 236 of the pilot portion, the elements of the self-attaching fastener 220 are numbered in the same sequence as the fastener 120 shown in Figure 7 and no further description is required.

20           **[00037]**        Figures 11 to 13 illustrate the fastener 220 attached to a panel 252 similar to Figures 4 to 6 with frangible wires 262 in the wire grooves 256 as described above in regard to Figures 7 and 22. As best shown in Figure 12, the panel portion 254 is thus deformed beneath both inclined walls 236 of the pilot portion and 248 of the flange portions, forming a dovetail-shaped recess and improved push-out strength for the fastener and panel assembly. All other elements are identical to the previous embodiments described above and are numbered in the same sequence such that no further description is required.

25           **[00038]**        Figures 14 to 16 illustrate a further alternative embodiment of the self-attaching fastener 320 of this invention which is particularly suitable for heavy or thicker panel metal applications. As will be understood by those skilled in this art, it is more difficult to deform thicker panel metal into confined recesses, such as the

-10-

dovetail-shaped recesses between the spaced arcuate segments 44 of the flange portions 38 as shown in the previous figures. Thus, in the embodiment of the self-attaching fastener 320 shown in Figures 14 to 16, the generally arcuate flange portions 338 are continuous on both sides of the central projecting pilot portion 330. Further, the inclined surface 348 of the flange portions 338 is arcuate at the center as shown in Figures 14 and 15, but the end portions 349 adjacent the end faces 326 are linear to provide additional torque resistance and bearing area for heavy metal applications. In the preferred embodiment, the end portions 339 of the generally arcuate flange portions 338 are linear as shown and the side faces 324 conform to the shape of the flange portions 338. Finally, the inclined surface 336 adjacent the primary bearing surface 342 is inclined, but the surface 337 adjacent the piercing face 334 is cylindrical, providing additional columnar strength for the pilot portion during piercing as best shown in Figure 16. Because of the improved torque resistance provided by the linear end portions 339 and 349 of the flange portions 338, the integral tabs have been eliminated. Other details of the embodiment of the self-attaching fastener 320 may be identical to the self-attaching fasteners described above and the elements are numbered in the same sequence such that no further description is required for a person of ordinary skill in this art.

[00039] Figures 17 and 18 illustrate a preferred embodiment of the self-attaching fastener 420 which is particularly suitable for installation and relatively thin panels. In this embodiment, the body is generally rectangular similar to Figure 7 and the pilot 430 is cylindrical having a cylindrical external surface 436. The inside wall 448 of the flange portions 438 are inclined inwardly from the first bearing surface 440 to the second bearing surface 442. More importantly, the antirotation feature of this embodiment comprises notches 449 which extend radially opposite the pilot 430 into the bearing surface 440 of the flange portions. In the preferred embodiment, the flange portions 438 include at least one notch in each of the flange portions, more preferably two notches 449 in each of the flange portions equally spaced from the planar ends 426 as shown. In the most preferred embodiment of the self-attaching fastener 420, the notches 449 are integrally struck from the flange portions forming radial tabs 443 overlying the second bearing surface 442. The radial notches in 449 and tabs 443 provide excellent torque resistance. Further pull-off strength may also be provided by

undercutting the pilot (not shown). Again, the elements of the self-attaching fastener 420 shown in Figures 17 and 18 are numbered in the same sequence as the previous figures such that no further description is necessary for a complete understanding of this embodiment.

5           **[00040]**       In the embodiment of the self-attaching fastener 520 shown in Figure 19, the arcuate flange portions 538 extend substantially around the pilot portion 530 and the opposed ends 546 are inclined inwardly from the first bearing surface 540 as shown. Further, the fastener is generally circular having planar end surfaces 526 and the tabs are replaced by planar surfaces 551 on opposed sides of the pilot portion 530.  
10   The planar surfaces 551 provide torsional resistance and additional panel bearing surface 542 between the pilot portion 530 and the flange portion 538, eliminating the requirement for tabs. Again, the elements of the self-attaching fastener 520 illustrated in Figure 19 is numbered in the same sequence as the previous embodiments, such that a person of ordinary skill in this art will not require any further description.

15           **[00041]**       Finally, the self-attaching fastener 620 illustrated in Figures 20 and 21 is similar to the self-attaching fastener 520 illustrated in Figure 19, except that the inclined surfaces 646 between the flange portions 638 are also inclined from the end faces 626 toward the pilot portion 630 thereby providing additional retention of the fastener on a panel (not shown) and the integral tab portions 650 drive panel metal into  
20   the V-shaped grooves defined between the flange portions, providing a very secure installation. Again, the elements of the self-attaching fastener 620 illustrated in Figures 20 and 21 have been numbered in the same sequence as the prior embodiments, such that further explanation is not required for a person of ordinary skill in this art.

**[00042]**       Having described several preferred embodiments of the self-  
25   attaching fasteners of this invention, the method of installation and the fastener and panel assemblies, it will be understood by a person of ordinary skill in this art that the various features of the disclosed embodiments can be combined in various combinations depending upon the application for the self-attaching fastener, including the thickness of the panel, the space available for the installation, etc. In the most  
30   preferred embodiments of the self-attaching fasteners of this invention, wherein push-off strength is desired, the surfaces of the flange portions facing the pilot portion are inclined from the primary bearing surface toward the pilot portion as shown, for

-12-

example, in the drawings illustrating the embodiments of the self-attaching fasteners 20, 120, 320, etc. Further, the preferred embodiments include antirotation or torque resistance means to prevent rotation of the fastener relative to the panel following installation particularly during threading of a bolt or male fastener into the nut bore. In one embodiment, a tab portion integrally struck from the pilot portion and extends radially toward the end faces of the self-attaching fastener. In another embodiment, particularly for thin metal applications, the self-attaching fastener includes flange portions comprising spaced arcuate segments, wherein the opposed surfaces of the segments are inclined toward each other from the main bearing surface toward the panel supporting surfaces of the flange portions providing increased push-off strength and torque resistance. In another preferred embodiment for thin metal applications, the flange portions include radial notches preferably integrally struck from the first bearing surface of the flange portions forming radial tabs extending toward the pilot portion overlying the second bearing surface. Finally, for thick metal applications, torque resistance is provided by flange portions having an arcuate midportion and linear end portions.

**[00043]** Where the self-attaching fastener of this invention is utilized as a self-piercing fastener, the end face of the pilot portion is preferably planer and the bearing surfaces of the flange portions are spaced below of the plane of the piercing face. Further, in self-piercing applications, the fastener is formed from steel having a hardness greater than the metal panel to which it is attached. Having described the preferred embodiments of the self-attaching fasteners of this invention, it will be understood by those skilled in this art that various modifications may be made to the fasteners within the purview of the appended claims.

**CLAIMS**

1. A self-attaching fastener, comprising:  
a generally cylindrical pilot portion having a planar annular end face, a bore extending through said pilot portion through said end face, spaced generally  
5 arcuate flange portions on opposed sides of said pilot portion spaced from said pilot portion each having a generally planar generally arcuate first bearing surface spaced below the plane of said end face, and a second generally planar bearing surface spaced below the plane of said first bearing surface located between said flange portions and said pilot portion and generally surrounding said pilot portion.  
10
2. The self-attaching fastener as defined in Claim 1, wherein said generally planar arcuate first bearing surfaces each comprise at least two spaced generally arcuate segments and said second generally planar bearing surface extends between said spaced generally arcuate segments.  
15
3. The self-attaching fastener as defined in Claim 2, wherein said spaced generally arcuate segments include opposed inclined surfaces angling inwardly from said second bearing surface to said first bearing surface.
- 20 4. The self-attaching fastener as defined in Claim 1, wherein said generally arcuate flange portions each include an inclined surface facing said pilot portion angling inwardly from said second bearing surface toward said pilot portion.
- 25 5. The self-attaching fastener as defined in Claim 4, wherein said inclined surface of said flange portions facing said pilot portion includes an annular conical midportion and linear inclined side portions on opposed sides of said midportion.
- 30 6. The self-attaching fastener as defined in Claim 1, wherein said generally arcuate flange portions each include an inclined surface facing said pilot portion angling inwardly from said second bearing surface toward said pilot portion.

-14-

7. The self-attaching fastener as defined in Claim 1, wherein said generally cylindrical pilot portion includes an angled outer surface inclined from said second bearing surface toward said flange portions.

5 8. The self-attaching fastener as defined in Claim 1, wherein said generally cylindrical pilot portion includes integral tab portions spaced below said plane of said end face overlying said second generally planar bearing surface.

10 9. The self-attaching fastener as defined in Claim 8, wherein said tab portions are integrally struck from said planar end face of said pilot portion and extend radially toward an end face of said self-attaching fastener and the pilot portion includes flat surfaces above said tab portions.

15 10. The self-attaching fastener as defined in Claim 1, wherein said self-attaching fastener includes planar end faces and arcuate side faces and said generally arcuate flange portions extend from said arcuate side faces.

20 11. The self-attaching fastener as defined in Claim 1, wherein said second bearing surface includes linear wire receiving grooves on opposed sides of said pilot portion.

12. The self-attaching fastener as defined in Claim 11, wherein said wire receiving grooves each include a bottom surface having a plurality of spaced pockets.

25 13. The self-attaching fastener as defined in Claim 1, wherein said generally cylindrical pilot portion includes a cylindrical surface adjacent said end face and an inwardly inclined frustoconical surface adjacent said second bearing surface.

30 14. The self-attaching fastener as defined in Claim 13, wherein said generally arcuate flange portions each include an inclined generally arcuate face opposite said inwardly inclined frustoconical surface of said pilot portion inclined inwardly from said first bearing surface to said second bearing surface.

-15-

15. The self-attaching fastener as defined in Claim 1, wherein said generally arcuate flange portions each include a surface opposite said generally cylindrical pilot portion having a notch extending into said first bearing surface.

5

16. The self-attaching fastener as defined in Claim 15, wherein said generally arcuate flange portions each include a plurality of said notches generally equally spaced in said generally arcuate flange portions.

10

17. The self-attaching fastener as defined in Claim 15, wherein said notch is integrally struck from said first bearing surface forming an integral tab overlying said second bearing surface extending toward said pilot portion.

18. A self-attaching fastener, comprising:

15 a generally cylindrical pilot portion having a planar annular end face, a bore extending through said pilot portion through said end face, spaced generally arcuate flange portions on opposed sides of said pilot portion spaced from said pilot portion including generally arcuate outer side faces, generally arcuate inner faces opposite said pilot portion, generally planar first bearing faces generally parallel to but  
20 spaced below the plane of said end face, a second generally planar bearing surface spaced below the plane of said first bearing surface located between said flange portions and said pilot portion and generally surrounding said pilot portion and said generally arcuate inner faces of said flange portions inclined inwardly from said first bearing surface to said second bearing surface.

25

19. The self-attaching fastener as defined in Claim 18, wherein said generally cylindrical pilot portion includes integral tab portions spaced below said plane of said end face.

30

20. The self-attaching fastener as defined in Claim 19, wherein said tab portions are integrally struck from said planar end face of said pilot portion and said tab



portions each extending radially toward an end face of said self-attaching fastener and said pilot portion includes flat surfaces above said tab portions.

21. The self-attaching fastener as defined in Claim 18, wherein said  
5 generally planar first bearing surfaces each comprise at least two spaced generally arcuate segments and said second planar bearing surface extending between said spaced generally arcuate segments of said flange portion.

22. The self-attaching fastener as defined in Claim 21, wherein said spaced  
10 generally arcuate segments include opposed faces inclined inwardly from said second bearing surface toward said first bearing surface.

23. The self-attaching fastener as defined in Claim 18, wherein said  
self-attaching fastener includes planar end faces.

15 24. The self-attaching fastener as defined in Claim 18, wherein said second bearing surface includes linear wire receiving grooves on opposed sides of said pilot portion.

20 25. The self-attaching fastener as defined in Claim 18, wherein said generally cylindrical pilot portion includes a cylindrical surface adjacent said end face and an inwardly inclined frustoconical surface adjacent said generally planar bearing surface opposite said generally arcuate inner faces of said flange portions.

25 26. The self-attaching fastener as defined in Claim 18, wherein said arcuate inner faces of said flange portions each include a notch extending into said first bearing surface.

27. The self-attaching fastener as defined in Claim 26, wherein said arcuate  
30 inner faces of said flange portions each include a plurality of said notches generally equally spaced in said arcuate inner faces of said flange portions.

28. The self-attaching fastener as defined in Claim 26, wherein said notch is integrally struck from said first bearing surface forming an integral tab overlying said second bearing surface extending toward said pilot portion.

5 29. The self-attaching fastener as defined in Claim 18, wherein said generally arcuate flange portions each include an arcuate midportion and integral linear end portions on opposed sides of said midportion.

30. A self-piercing nut, comprising:  
10 a nut body including a primary planar bearing surface having generally planar end faces and generally arcuate side faces, a central tubular generally cylindrical pilot portion projecting from said primary bearing surface including an annular planar piercing face, a bore extending through said pilot portion through said piercing face and integral tab portions extending radially toward said end faces overlying said primary  
15 bearing surface spaced below the plane of said piercing face, and spaced generally arcuate flange portions projecting from said primary bearing surface at said generally arcuate end faces on opposed sides of said pilot portion including planar panel support surfaces spaced below the plane of said piercing surface and side faces facing said pilot portion inclined from said primary bearing surface toward said pilot portion.

20 31. The self-piercing nut as defined in Claim 30, wherein said generally arcuate flange portions each comprise at least two spaced generally arcuate segments each having opposed inclined surfaces angling outwardly from said primary bearing surface toward said planar panel support surfaces.

25 32. The self-piercing nut as defined in Claim 30, wherein said pilot portion includes an angled outer surface inclined from said primary bearing surface toward said flange portions.

30 33. The self-piercing nut as defined in Claim 32, wherein said generally cylindrical pilot portion includes a cylindrical portion surface adjacent said piercing face.

-18-

34. The self-piercing nut as defined in Claim 30, wherein said integral tab portions are integrally struck from said piercing surface of said pilot portion.

5 35. The self-piercing nut as defined in Claim 30, wherein said inclined side faces facing said pilot of said flange portion include an arcuate midportion and linear inclined side portions on opposed sides of said midportion.

10 36. The self-piercing nut as defined in Claim 30, wherein said primary bearing surface includes wire receiving grooves on opposed sides of said pilot portion extending from said end faces of said body portion between said pilot portion and said flange portions.

15 37. The self-piercing nut as defined in Claim 30, wherein said generally arcuate flange portions each include a notch extending into said planar panel support surfaces.

20 38. The self-piercing nut as defined in Claim 37, wherein said notch is integrally struck from said panel support surfaces forming an integral tab overlying said primary bearing surface and extending toward said pilot portion.

39. A self-attaching nut fastener, comprising:  
a generally cylindrical pilot portion having a planar annular end face, a bore extending through said pilot portion through said end face, flange portions on  
25 opposed sides of said pilot portion each having an arcuate midportion, integral end portions on opposed sides of said midportion, a planar first bearing surface generally parallel to said end face of said pilot portion spaced below the plane of said end face and a side face opposite said pilot portion forming a panel receiving groove, and a second generally planar bearing surface spaced below the plane of said first bearing  
30 surface located between said flange portions and said pilot portion and generally surrounding said pilot portion.

40. The self-attaching nut fastener as defined in Claim 39, wherein said side face of each of said flange portions is inclined inwardly from said first bearing surface to said second bearing surface.

5 41. The self-attaching nut fastener as defined in Claim 39, wherein said flange portions each include a notch extending into said first bearing surface opposite said pilot portion.

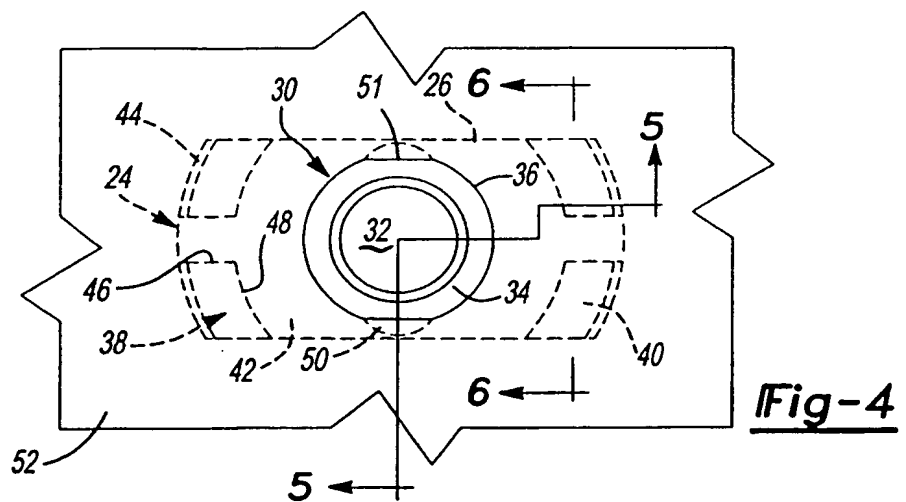
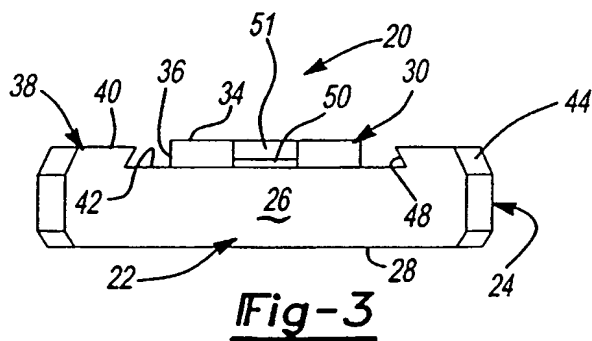
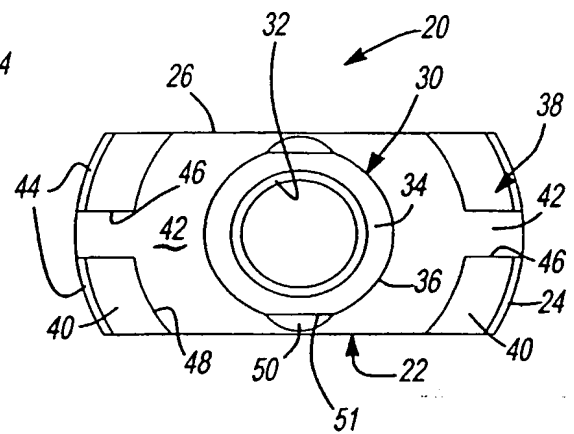
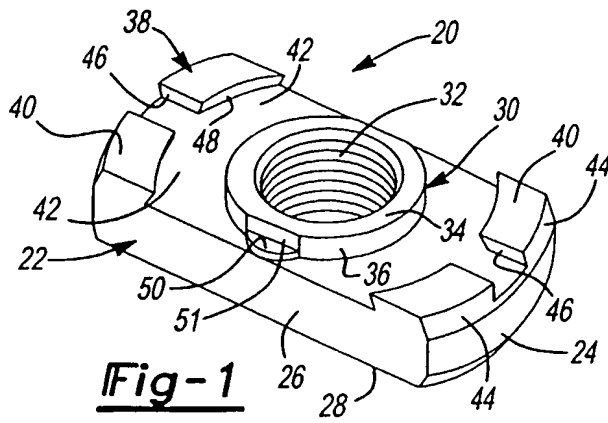
10 42. The self-attaching nut fastener as defined in Claim 39, wherein said notch is integrally struck from said first bearing surface forming an integral tab overlying said second bearing surface and extending toward said pilot portion.

15 43. The self-attaching nut fastener as defined in Claim 41, wherein said flange portions each include a plurality of generally equally spaced notches.

20 44. The self-attaching nut fastener as defined in Claim 39, wherein said generally cylindrical pilot portion includes a cylindrical surface adjacent said end face and an inwardly inclined frustoconical surface adjacent said second generally planar bearing surface.

45. The self-attaching nut fastener as defined in Claim 39, wherein said generally cylindrical pilot portion includes an integral radial tab spaced below the plane of said end face overlying said second generally planar bearing surface.

1/6



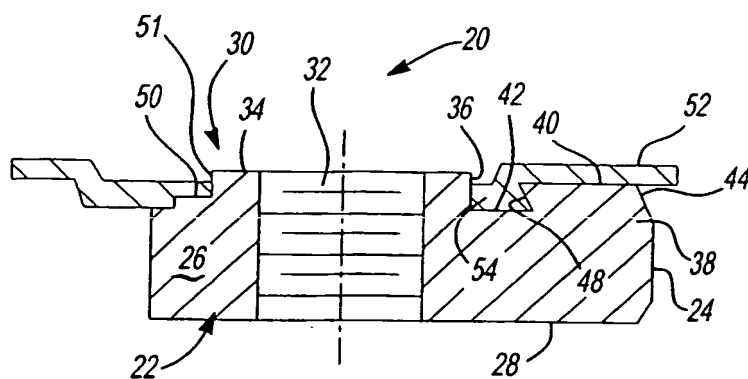


Fig-5

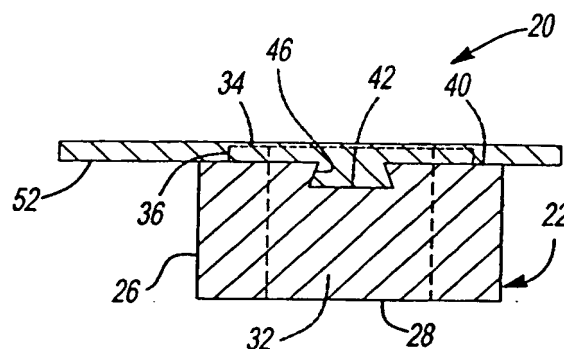


Fig-6

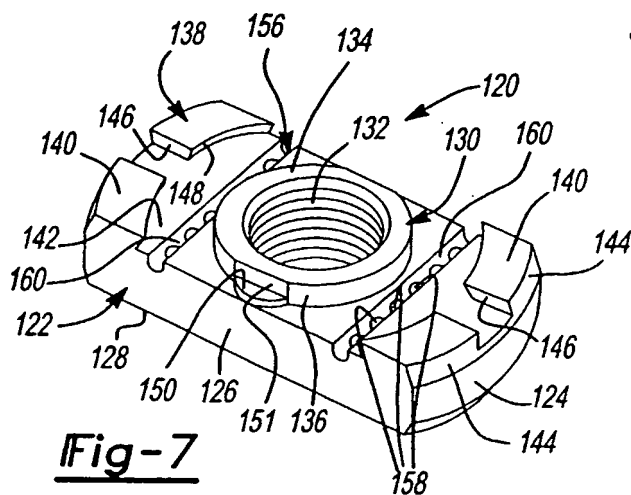
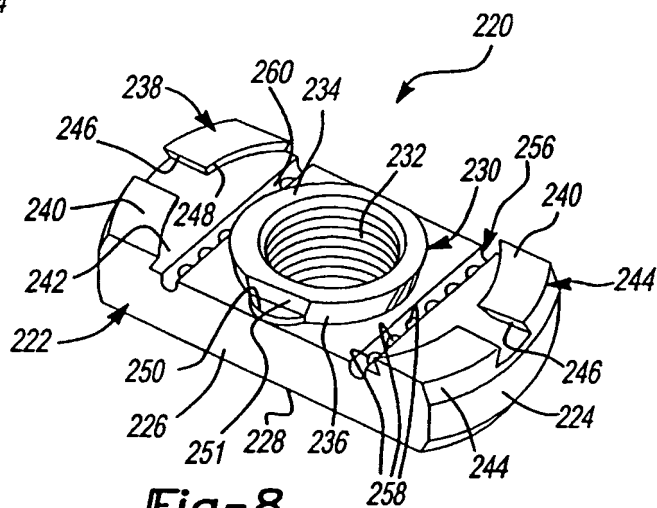


Fig-7



**Fig-8**

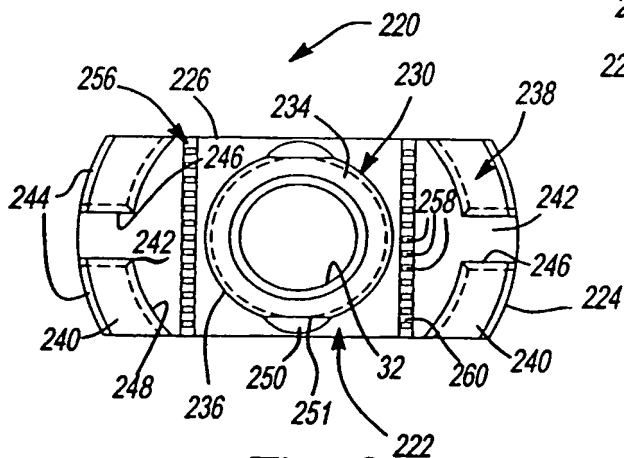
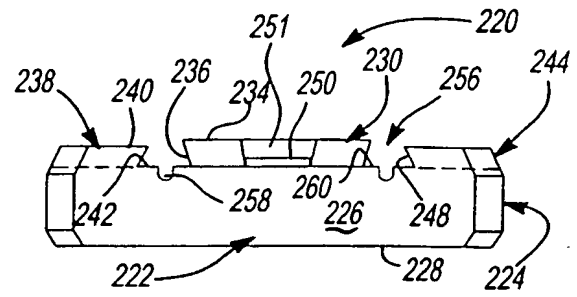
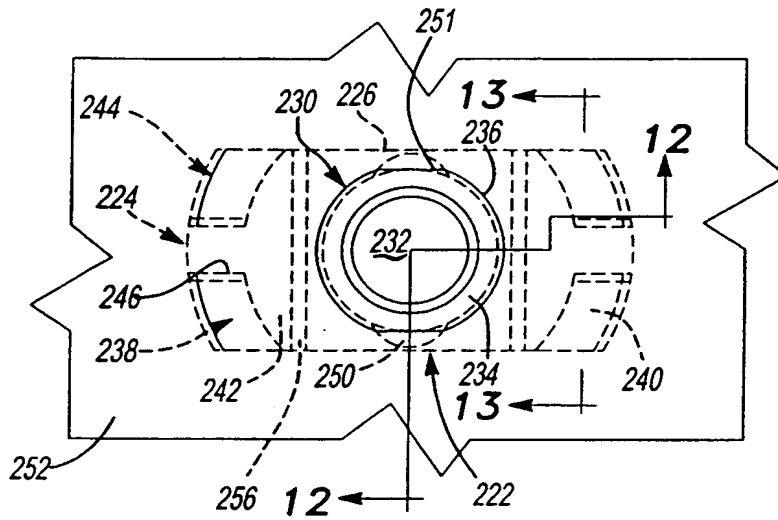


Fig-9

3/6

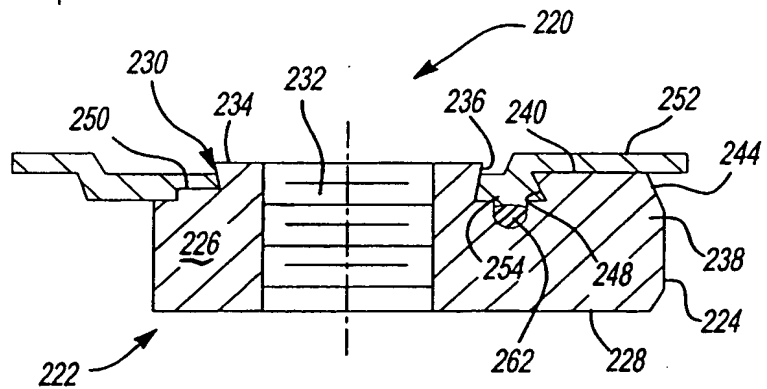


**Fig-10**

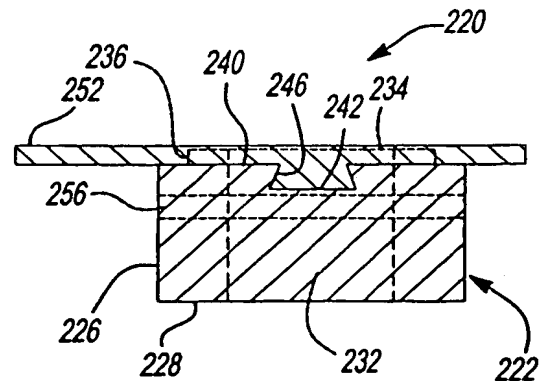


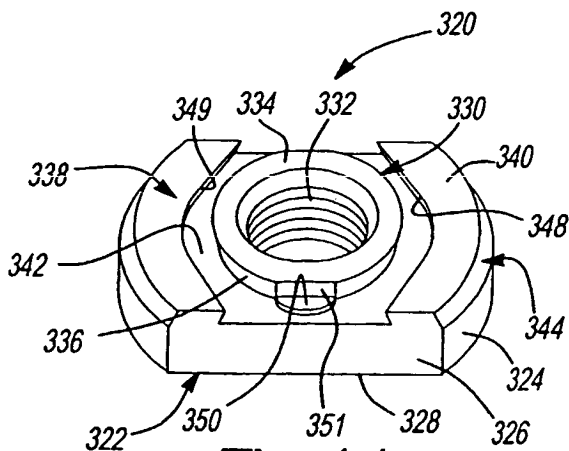
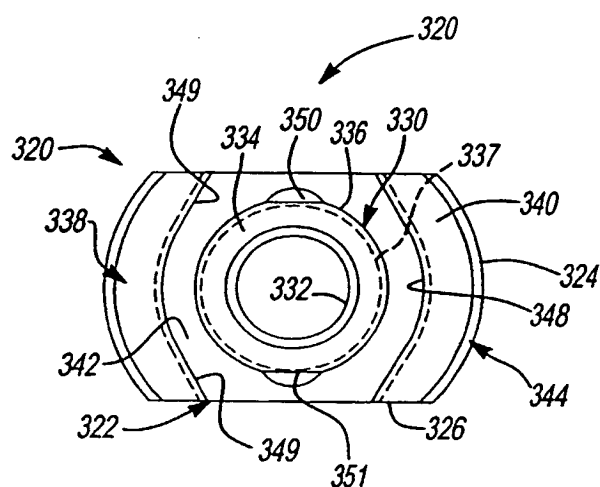
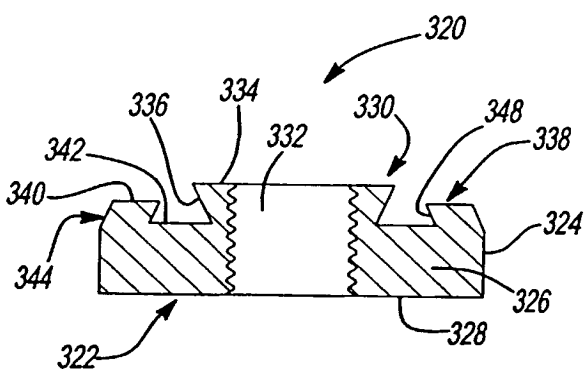
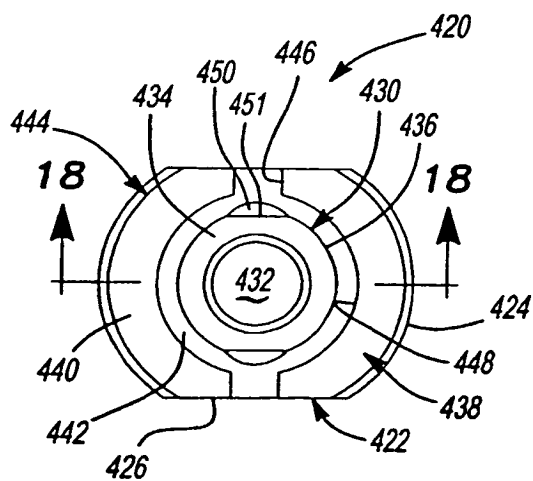
**Fig-11**

**Fig-12**

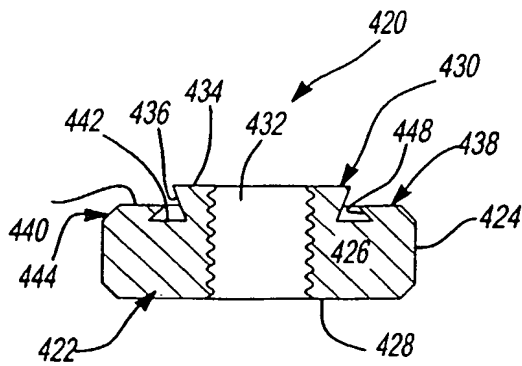


**Fig-13**

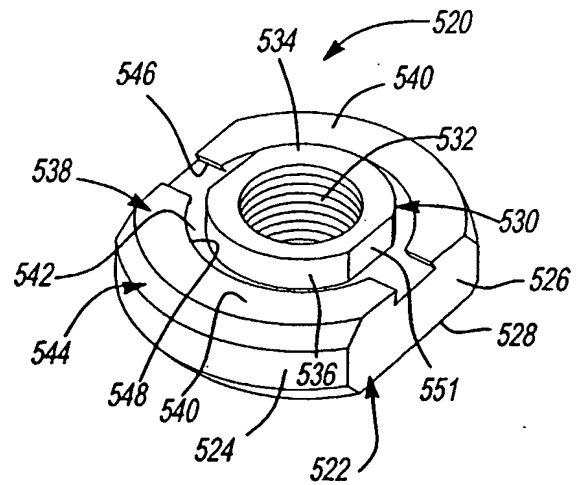


**Fig-14****Fig-15****Fig-16****Fig-17**

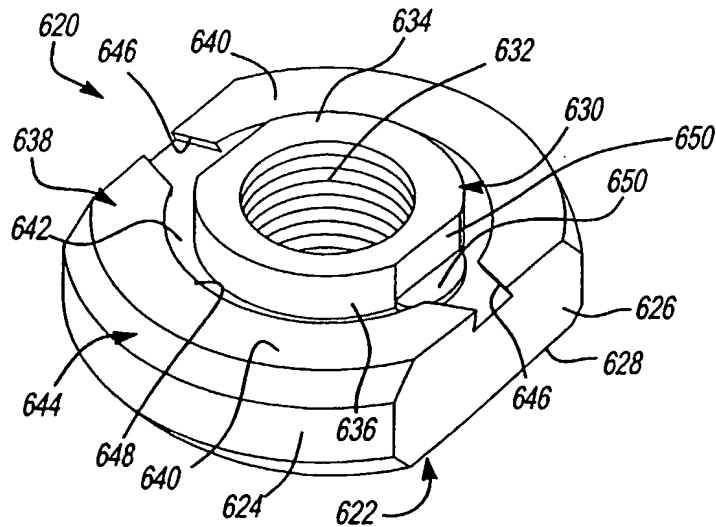




**Fig-18**

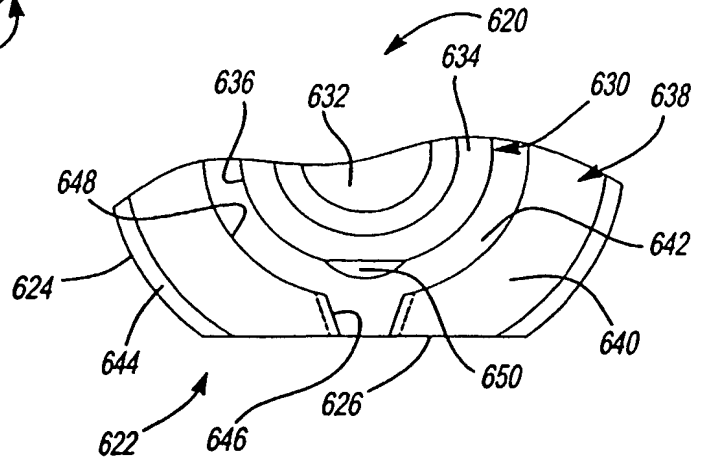


**Fig-19**



**Fig-20**

**Fig-21**



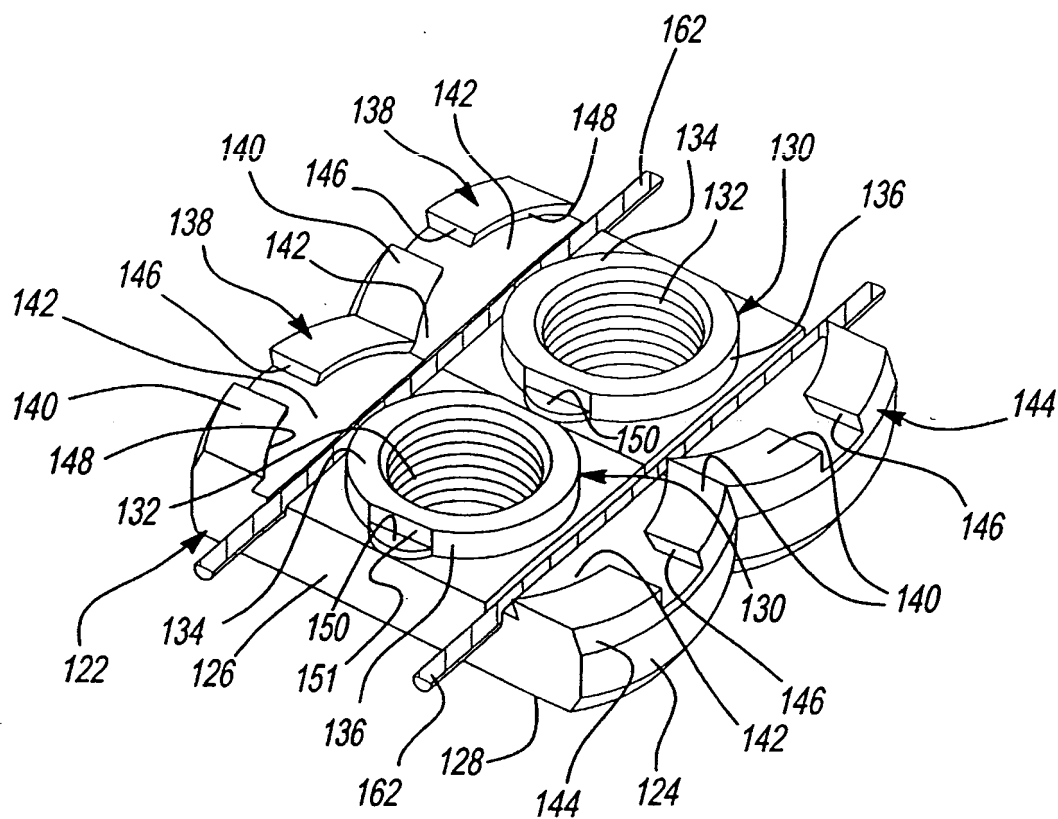


Fig-22

# INTERNATIONAL SEARCH REPORT

International Application No  
**PCT/US 02/24175**

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 F16B37/06

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 F16B B23P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 669 473 A (MULTIFASTENER CORP) 30 August 1995 (1995-08-30)	1,4,6,8, 9,13,14, 18-20, 25,30, 34,39, 40,44,45
Y	abstract; figures 1-6	2,3,5,7, 11, 15-17, 21,22, 24, 26-29, 31-33, 35-38, 41-43
A	--- -/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*&\* document member of the same patent family

Date of the actual completion of the international search

8 November 2002

Date of mailing of the international search report

18/11/2002

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Bousquet, K

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 02/24175

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 432 681 A (CAPUANO TERRY D) 21 February 1984 (1984-02-21)  abstract; figures 2-7 ----	2,3,5,7, 21,22, 29,31,35
Y	US 3 711 931 A (LADOUCEUR H ET AL) 23 January 1973 (1973-01-23) cited in the application	11,24,36
A	abstract; figures 3,8 ----	12
Y	US 3 648 747 A (STEWART JOHN H) 14 March 1972 (1972-03-14) cited in the application	32,33
A	abstract; figures 3,4 ----	1,3
A	US 4 690 599 A (SHINJO KATSUMI) 1 September 1987 (1987-09-01) abstract; figures 1-3 ----	2,21,31, 35
Y	US 4 389 766 A (CAPUANO TERRY D) 28 June 1983 (1983-06-28)  column 5, line 52 -column 6, line 6; figures 3,4 -----	15-17, 26-28, 37,38, 41-43

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 02/24175

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0669473	A	30-08-1995	JP 2816645 B2 JP 7238915 A US 5531552 A CA 2143363 A1 DE 69507348 D1 DE 69507348 T2 EP 0669473 A1 US 5549430 A	27-10-1998 12-09-1995 02-07-1996 26-08-1995 04-03-1999 24-06-1999 30-08-1995 27-08-1996
US 4432681	A	21-02-1984	CA 1183375 A1 DE 3268509 D1 EP 0066260 A1 JP 1462521 C JP 58000611 A JP 63009128 B US 4543023 A	05-03-1985 27-02-1986 08-12-1982 14-10-1988 05-01-1983 26-02-1988 24-09-1985
US 3711931	A	23-01-1973	AU 3320171 A CA 991966 A1 CA 991829 A2 CA 979188 A2 DE 2140226 A1 FR 2135945 A5 GB 1358099 A IT 948130 B JP 54025177 B US 3845860 A ZA 7105616 A	15-03-1973 29-06-1976 29-06-1976 09-12-1975 12-10-1972 22-12-1972 26-06-1974 30-05-1973 25-08-1979 05-11-1974 26-07-1972
US 3648747	A	14-03-1972	NONE	
US 4690599	A	01-09-1987	JP 1383686 C JP 58109710 A JP 61049528 B DE 3247555 A1	09-06-1987 30-06-1983 30-10-1986 14-07-1983
US 4389766	A	28-06-1983	DE 3172690 D1 EP 0041593 A1 ES 267615 Y	28-11-1985 16-12-1981 16-11-1983

